Fort Future Utility Systems Tools

ERDC/CERL TN-03-6 Rev. August 2004

Background

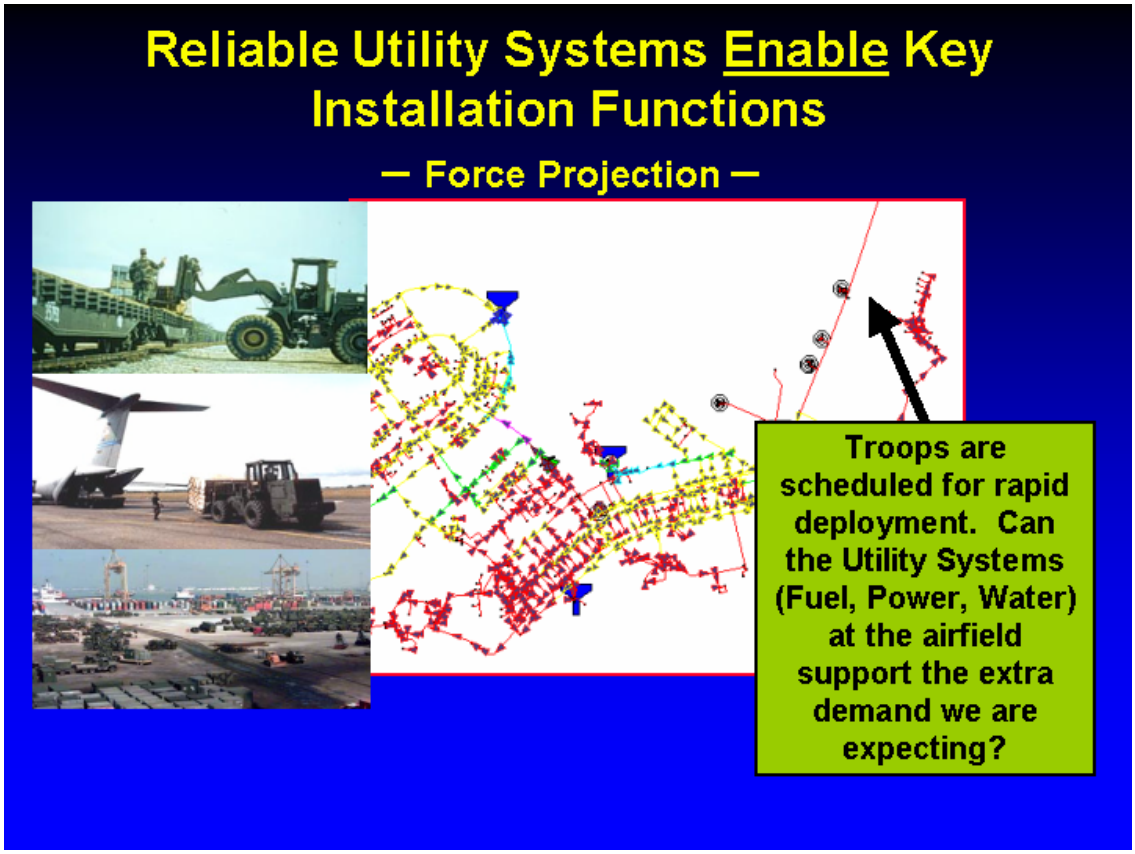
Utility systems are "enablers" for almost every activity on an installation. They provide the electricity, water, transportation fuel, heating, cooling, compressed air, and communications required for the various steps of force projection.

Problem

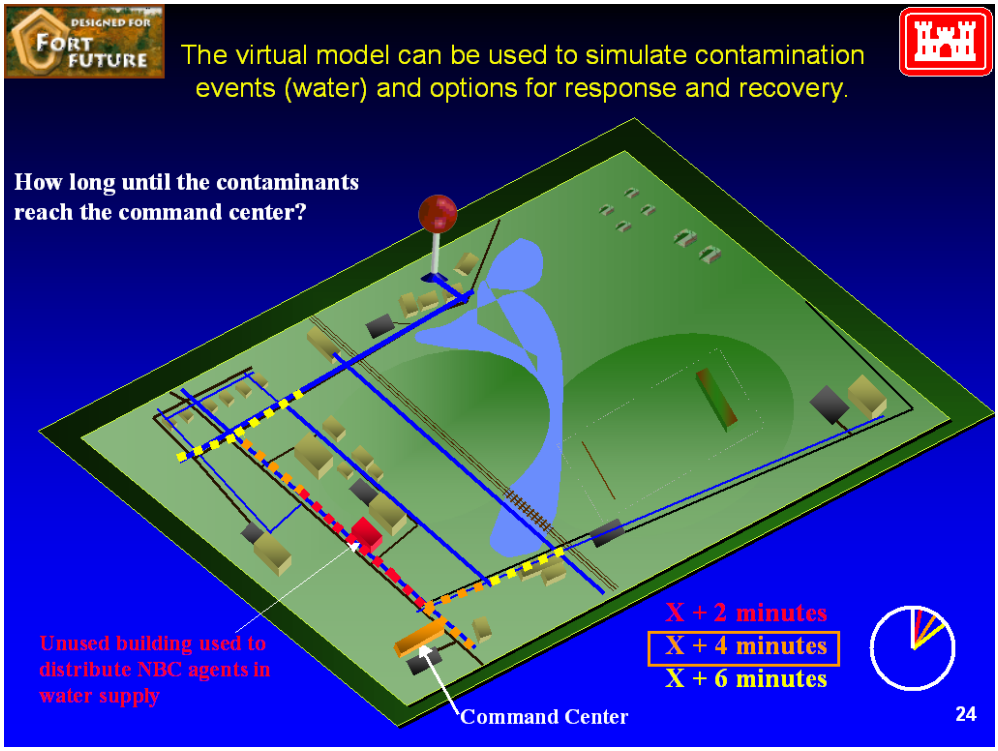
Safe, reliable utility service is often taken for granted. Because of their enabling role in so many activities on military installations, utilities systems are attractive targets for terrorists. Attack or sabotage on a utility system can potentially delay time-critical missions and pose threats to health and life. For example, destruction of an electrical substation could cause a power interruption for thousands of occupants. Terrorists could also introduce a chemical or biological contaminant into potable water or fuel supplies. Determination of the best response to such emergencies and threats requires advance planning.

Other utility system problems can also result in serious consequences. One such problem is the unintentional failure of aging utility infrastructure. This can cause service interruptions such as the massive power outage that occurred in the Northeast United States in August 2003. Another problem is inadequate capacity. The ability of today's utilities systems to support the capacity requirements of the Future Force requires analysis.

Modeling and simulation tools can aid in utility contaminant prevention, detection, and mitigation.



A simulation of what will happen if a contaminant is introduced into a water system can help engineers plan the best response.



Each installation is unique in terms of physical location, characteristics, condition of facilities, and mission. All of these factors impact the capability of a utility network to provide safe and reliable service. Unfortunately, due to the nature of utility systems, no "one-size-fits-all" solution exists.

Approach

Water and electrical distribution system simulations are currently being added to the Fort Future Virtual Installation and are scheduled for completion in September 2004. Addition of a fuel system model is planned for FY05. Other utility system models are being considered for inclusion in FY06 and beyond.

The Virtual Installation is a computable model of a given geographic location that is built on a GIS platform and includes buildings, roads, and other infrastructure. Processes such as deployment preparations or manufacturing can be overlaid onto the virtual infrastructure and simulated. The impact of various policies, factors, or events can be simulated quickly and easily.

Existing data from the installation's ArcGIS, Microstation, AutoCAD, or other electronic drawing/map repository is used to create the various layers of the Virtual Installation, including the utility systems. Thus, tedious and/or duplicate data entry is minimized. Users can view utility system layouts and components within the Virtual Installation by simply switching them on.

Once a virtual model of a utility system has been created within the Virtual Installation, the user can simulate its behavior and conduct several types of analysis based on the results. Engineering analysis algorithms and models have been incorporated to calculate various operational parameters. For example, the Environmental Protection Agency's "EPANet" software has been incorporated to calculate pressures, flow rates, water velocities, and other operating data over time for water distribution systems.

The user will also be able to simulate events that impact and/or rely upon utility systems, such as addition of a new facility or activity, firefighting at multiple locations, interruption of service, or introduction of a waterborne contaminant. This will be done by simply pointing and clicking on the map and specifying some very basic information.

Simulating a firefighting situation can help determine if the water system's capacity is adequate.

Heuristics are being developed to help the user answer the following "real world" questions:

- Capacity: Is there enough water/power to meet the requirements? If not, what can we do about it?
- Vulnerability: Which components of the utility system are susceptible to attack or damage?
- Interruption of service: What would happen if water/power service was interrupted? Which facilities or processes would have to rely on backup supplies? Are backup supplies adequate? What would be the impact on mission-critical activities?
- Contamination: What would happen if a contaminant was introduced into the water distribution system? Where would it go and how long would it take to reach critical buildings? What action should we take?

Utility system analysis software as it exists today typically requires that scenario information be input manually, and that an expert user be available to interpret the results. One of the goals of the Virtual Installation is to be a simple and highly visual way to convey analysis results. Thus, the results of all of these analyses will be shown to the user on a Virtual Installation map.

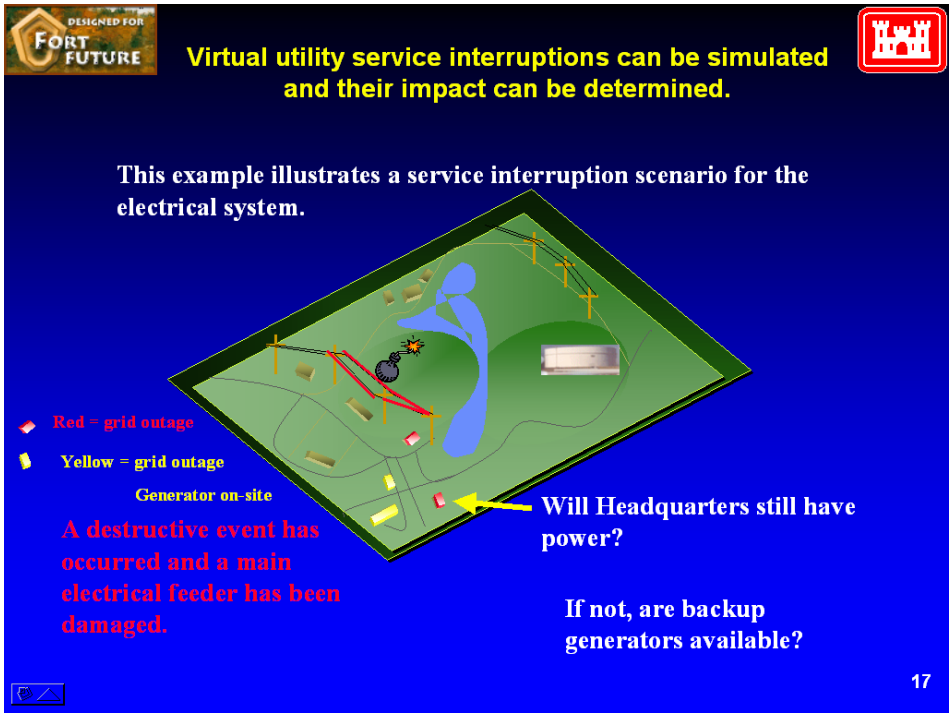
The cross-functional nature of the Virtual Installation allows easy setup of scenarios for analysis. The post-analysis algorithms within the Fort Future utilities tools will provide a basic interpretation of the results to non-technical users and will help determine if a proposed solution is worthy of further, more detailed consideration.

Benefits

Fort Future utilities tools will enable the user to:

- Easily create a virtual model of each installation's "as-is" electrical, potable water, fuel, and natural gas distribution systems as part of the "Virtual Installation"
- Identify areas with inadequate utility system capacity in the present or future, based on actual or proposed plans and activities

The impact of a service interruption can be modeled so an installation can take appropriate preventive action.



- Pinpoint locations that are the most vulnerable to interruption or denial of utility service
- Simulate contamination events and analyze potential responses (water and fuel)
- Test alternative solutions to the utility system problems or deficiencies that are identified
- View analysis results and their interpretation on the map.

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